January 2007

CURRENT AND HISTORICAL USE OF ALPHA-CHLORALOSE ON WILD TURKEYS

David Bergman
US Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services

Brian F. Wakeling
Arizona Game and Fish Department

Timothy B. Veenendaal
US Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services

John D. Eisemann
USDA/APHIS/WS National Wildlife Research Center, John.D.Eisemann@aphis.usda.gov

Thomas W. Seamans
USDA/APHIS/WS National Wildlife Research Center, thomas.w.seamans@aphis.usda.gov

CURRENT AND HISTORICAL USE OF ALPHA-CHLORALOSE ON WILD TURKEYS

David L. Bergman[1]
US Department of Agriculture,
Animal and Plant Health Inspection Service,
Wildlife Services, 8836 N 23 Avenue, Suite 2,
Phoenix, AZ 85021, USA

Brian F. Wakeling
Arizona Game and Fish Department, Game Branch,
2221 West Greenway Road,
Phoenix, AZ 85023, USA

Timothy B. Veenendaal
US Department of Agriculture,
Animal and Plant Health Inspection Service,
Wildlife Services, 8836 N 23 Avenue, Suite 2,
Phoenix, AZ 85021, USA

John D. Eisemann
US Department of Agriculture,
Animal and Plant Health Inspection Service,
Wildlife Services, National Wildlife Research Center,
4101 LaPorte Avenue, Fort Collins, CO 80521, USA

Thomas W. Seamans
US Department of Agriculture, Animal and Plant Health Inspection Service,
Wildlife Services, National Wildlife Research Center,
% Plum Brook Station, 6100 Columbus Avenue,
Sandusky, OH 44870, USA

Abstract: Alpha-chloralose (AC) has been used as an anesthetic since 1897 to capture or sedate wildlife, including waterfowl, wood-pigeon (*Columba palumbus*), and black bear (*Ursus americana*). The first use of AC in the United States was for the capture of house sparrows (*Passer domesticus*), red-winged blackbirds (*Agelaius phoeniceus*), and wild turkeys (*Meleagris gallopavo*) in 1964. Prior to the 1990s, AC was not registered by the Food and Drug Administration (FDA) for use as an immobilizing agent in the United States for wild animals that might be used for human consumption. In 1992, the FDA granted the US Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) an Investigative New Animal Drug for AC to capture waterfowl, American coots (*Fulica americana*), and pigeons (rock doves, *Columba livia*). During the late 1990s, ravens (*Corvus corax*) were added the species list on which AC could be used. In 2004, the FDA authorized the addition of sandhill cranes (*Grus canadensis*) to the list. Knowing that AC had been used on turkeys, the Arizona Game and Fish Department requested WS assistance in reintroducing Gould's turkeys (*Meleagris gallopavo mexicana*) to southeastern Arizona. To reduce stress on the birds during handling and testing, we sedated turkeys at the rate of 2.04 g of AC per 1 cup of cracked corn for up to 3 turkeys. In 2003 and 2004, wild turkeys were sedated during quarantine trials, fully recovered from the sedation and were available for relocation. Based on these data and a review of the published literature, we recommend that AC should be considered for future sedations of wild turkeys and that wild turkeys be considered for inclusion on the current Investigative New Animal Drug (INAD) label for AC.

Proceedings of the National Wild Turkey Symposium 9:51–57

Key words: alpha-chloralose, anesthesia, Arizona, chloralose, drug, Gould's wild turkey, *Meleagris gallopavo mexicana,* narcosis, reintroduction, sedation.

Many techniques have been used to capture wild turkeys for management purposes during all stages of the life cycle. Oral drugs have been used successfully, yet clinical trials and FDA approval is lacking for some types. Alpha-chloralose ($C_8H_{11}Cl_3O_6$ is a chloral derivative of glucose, which depresses the cortical centers of the brain but does not affect the medulla (Borg 1955). Alpha-chloralose has been used in laboratory

[1] E-mail: David.L.Bergman@aphis.usda.gov

animals since 1897 (Balis and Monroe 1964), and has been used to capture free-ranging wildlife species since 1966 (Williams 1966).

From the 1960s through the mid-1990s, AC was used as a capture technique, but had not been approved for use as a capture agent in the United States by the FDA (Belant et al. 1999). The FDA, Center for Veterinary Medicine, Office of New Animal Drug Evaluation's website (http://www.fda.gov/cvm/aboutona.htm) states the following: ''major responsibility is to review information submitted by drug sponsors who desire to obtain approval to manufacture and market animal drugs. A new animal drug is deemed unsafe unless there is an approved new animal drug application. Virtually all animal drugs are ''new animal drugs'' within the meaning of the term in the Federal Food, Drug, and Cosmetic Act'' (21 U.S.C. 301). There are 2 main processes involved in regulating the interstate shipment of animal drug products. The first process, the INAD exemption, involves the interstate shipment of experimental drugs used for testing in animals. This testing may require drugs be given to animals that will later be used to produce human food products. The FDA must ensure that food products derived from these experimental animals will be safe for human consumption. The second process is the New Animal Drug Application (NADA) review. It includes the evaluation of data regarding an animal drug's safety to the target animal and to humans who might consume products from the treated animal; the review also evaluates effectiveness for the purposes claimed. To be legally marketed, a new animal drug product must be approved under a NADA.

In 1992, WS received approval from the FDA to use AC under an INAD (Woronecki et al. 1990, Woronecki et al. 1992). Currently, AC is approved for use on waterfowl, coots, pigeons, ravens, and sandhill cranes.

The stated objective of Arizona Game and Fish Department's (AGFD) Wildlife Management Strategic Plan was to maintain the range of all subspecies of turkey in Arizona by repopulating historical range through transplants, with emphasis on the reintroduction of Gould's turkey (Arizona Game and Fish Department 2001). Arizona Game and Fish Department and the National Wild Turkey Federation (NWTF) approached WS for assistance in the reestablishment of the Gould's turkey, because WS held the only INAD for AC in the United States, AC had been used successfully on wild turkeys in the past, and there was a critical need to minimize handling stress on the newly acquired birds.

Initial efforts to reestablish Gould's turkey occurred during 1983 and 1987 (Breland 1988). In 1983 and 1987, Gould's turkey were captured near Nuevas Casas Grandes, Chihuahua, Mexico, transported to the United States, and held in mandatory quarantine as stipulated by the USDA APHIS Veterinary Services (VS). Approximately 60% of both groups died while in the 30-day quarantine prior to the release in the Huachuca Mountains of Arizona (Breland 1988). During the winter of 1994 and 1997, Gould's turkeys were captured near Yecora, Sonora, Mexico, and free released (non quarantine) into the Galiuro Mountains of Arizona (Wakeling 1998). This effort failed due to poor habitat suitability, as well as poor reproductive performance, high predator density, poor climatic conditions, high initial mortality due to handling related stress (Wakeling et al. 2001), and possibly, capture myopathy. Capture myopathy, also known as exertional myopathy, is a non-infectious disease characterized by skeletal and cardiac muscle necrosis and severe metabolic disturbance following extreme exertion, struggle, or stress (Williams and Thorne 1996). Capture myopathy has not been extensively diagnosed in avian species, but it has been diagnosed previously in wild turkeys (Spraker et al. 1987).

Arizona Game and Fish Department, in cooperation with NWTF and the Republic of Mexico, imported Gould's turkeys from Mexico to be held in a quarantine facility prior to release during 2003 and 2004. Our objective was to use AC to reduce stress and minimize or eliminate losses of Gould's turkeys due to handling. Ultimately, the goal was to obtain adequate data, including a literature review, unpublished studies, and research data collected under an amendment to the INAD to petition FDA to add turkeys to the list of approved species specified under the INAD.

STUDY AREA

We studied the effects of AC on Gould's turkeys in a VS approved quarantine facility (Maddrey and Wakeling *this volume*) in the Chiricahua Mountains located in Cochise County, Arizona, USA. The USDA requires that all poultry entering the United States from a foreign country be shipped under a USDA import permit and be quarantined for a minimum of 30 days at a USDA Animal Import Center. The USDA defines wild turkeys as poultry; wild turkeys are consequently subject to the import requirements for poultry. Due to the quality of the new facility, Arizona was granted permission to transport the turkeys directly to the new facility instead of one of the import facilities in New York, Florida, or California.

METHODS

AC Use

A formal request had to be made to the FDA to use AC on Gould's turkeys because they were a species of wildlife that was not covered by the INAD. All use of AC occurred within the AGFD facility. Prior to anesthetizing Gould's turkeys, food and water were removed to ensure the birds would readily feed on the treated cracked corn, and to remove potential drowning sources while the turkeys were narcotized. Turkeys were anesthetized with either 2.04 g of AC per cup of cracked corn and 10 ml of corn oil or 2.04 g of AC per 648 g of cracked corn and 20 ml of corn oil, not to exceed 180-mg/kg body weight. Locally purchased cracked corn was sifted to remove dust and chaff. The

Table 1. Dose response data for Gould's wild turkeys treated with alpha-chloralose laced cracked corn during 2003 and 2004 in a quarantine facility in the Chiricahua Mountains, Arizona, USA.

Date	Amount of cracked corn	Amount of AC (g)	Amount of corn oil (mL)	Number of Gould's turkeys feeding	Time baits placed (hr)	Time of first feeding (hr)	Time of first capture (hr)	Number captured	Number recovered
4 Apr 2003	3240 g	8.77	100	22	1500	1512	NA	0	NA
4 Apr 2003	2592 g	7.14	80	18	1505	1518	NA	0	NA
5 Apr 2003	7 cups	14.28	70	22	0935	0937	1356	22	22
5 Apr 2003	5 cups	10.20	50	18	0901	0903	1252	18	18
30 Mar 2004	7 cups	14.28	70	20	0905	0921	1545	20	20
30 Mar 2004	8 cups	16.32	80	22	0905	0912	1500	22	22
20 Apr 2004	7 cups	14.28	70	20	Not required	Not required	Not required	20	20
20 Apr 2004	8 cups	16.32	80	24	Not required	Not required	Not required	24	24

required quantity of cleaned cracked corn was placed in a clear sealable storage bag. Pre-packaged AC in the amount of 2.04 g was added to the bag and shaken to distribute, followed by corn oil. The corn oil aided adherence of the AC to the corn. Each bag was used to sedate up to 3 turkeys. One bag of treated corn was used per bait pile, with piles spaced 1–3 m apart. Turkeys were monitored for signs of anesthesia based on symptoms as described by Williams et al. (1973*a*). While under anesthesia, turkeys were radio-collared, patagial tagged, and cloacal swabs were taken for Exotic Newcastle Disease and avian influenza. Turkeys were held in NWTF weatherproof cardboard boxes until recovery.

Literature Review

Literature searches were conducted on 11 databases to find published and unpublished reports of AC use on wild turkeys. Databases searched were AGRICOLA, Biological Sciences, CAB abstracts, CRIS, Google, Forest Service Research Publications, Proceedings of the National Wild Turkey Symposia, PubMed, Searchable Ornithological Research Archive, TEOMA, Wildlife Ecology and Studies Worldwide, and Zoological Record. Literature found was used to glean pertinent and potential registration data and build a bibliography to justify future use and registration submissions.

RESULTS

AC Use

The FDA required that the appropriate documentation of National Environmental Policy Act be completed prior to granting approval to use an INAD on a species for which it is not labeled (e.g., Gould's turkeys). WS used Categorical Exclusions to document relevant environmental effects. In addition, WS had to assure FDA that the turkeys would not be hunted for food for at least 30 days after treatment; this was accomplished because Gould's turkeys are a protected species in the Chiricahua Mountains. FDA granted approval to use AC on Gould's turkeys in Arizona on 13 March 2003.

Forty turkeys were treated with AC on 4 April 2003 (Table 1). At the previously stated dosing regimens, all turkeys received adequate doses to facilitate capture with minimal stress to the animal. A second capture operation occurred on 5 April 2003 using 2.04 g per cup of cracked corn (Table 1). For operational purposes, all birds were assumed to weigh approximately 4.0 kg. Forty birds were treated, captured, and all survived. Within 23 min of the first feeding of group 1 (22 turkeys), 4 turkeys were showing signs of heavy sedation or mild narcosis. After 93 min, 14 turkeys showed signs of moderate narcosis or shallow anesthesia, 4 showed signs of heavy sedation or mild narcosis, and 4 showed no signs or light sedation. After 4 hr and 10 min, turkeys were hand captured and placed in NWTF boxes. Two females had to be hand netted. In group 2 (18 turkeys), within 57 min, 8 turkeys showed signs of heavy sedation or mild narcosis, 4 showed signs of moderate narcosis or shallow anesthesia, and 6 showed no signs or light anesthesia. After 4 hr, 11 turkeys were captured and placed in boxes. After 5 hr and 19 min, 1 additional turkey was sedated and 6 females had to be hand netted.

On 30 March 2004, the second set of captured turkeys was baited using the same dosing regimen (Table 1). Group 1 was baited at 0905 hr, and the first female showed signs of light sedation after 40 min. The first female reached moderate narcosis within 65 min of feeding. After 3.5 hr, only 5 turkeys had reached narcosis. After 5 hr and 15 min, 10 turkeys had reached narcosis and 10 had to be captured with a net. In group 2, feeding on the bait began 25 min after placement in the room. One female showed signs of heavy sedation or mild narcosis after 30 min. One female showed signs of moderate narcosis 80 min after feeding. At 5.5 hr after feeding, captures were begun. Twenty-one turkeys were in moderate narcosis to anesthesia. Three birds were in mild narcosis and 2 never fed. At 0645 hr the next morning, 5 were still in anesthesia, 3 were in mild narcosis, and 44 were under light sedation or recovered.

During the third baiting, times of feeding and symptoms of recovery were not noted due to changes in forms and the required information needed for the FDA (Table 1). All 44 turkeys fully recovered, and none were lost due to drugging. Turkeys captured during baiting 1 and 2 were outfitted with radio-collars and patagial tags.

Table 2. Published reports of use of alpha-chloralose to anesthetize wild turkeys through 2004 as found through online searches.

Citation	Recommended AC dosage (g) per cup of cracked corn	Sample size	State of use	Mortality (%)	Post capture observation (hr)
Williams 1966	2	260	Florida	Not noted	24–120
Williams et al. 1966	2	592	Florida	8.9	Not noted
Williams et al. 1968*a*	2	35	Florida	Not noted	Not noted
Williams et al. 1968*b*	2	26	Florida	0	72
Speake et al. 1969	2	98	Alabama	0	Not noted
Barwick et al. 1970	2	Not noted	Florida	Not noted	Not noted
Gardner 1972	2	115 w/3 methods	Alabama	Not noted	Not noted
Austin et al. 1973	2	1712	Florida	9.0	Not noted
Barwick and Speake 1973	2	105	Alabama	Not noted	24–36
Hillestad 1973	2	15	Alabama	Not noted	Not noted
Williams et al. 1973*a*	2	1600	Florida	9.0	20–40
Williams et al. 1973*b*	2	56	Florida	Not noted	Not noted
Windham 1973	2	4	Texas	25	29
Speake et al. 1975	2	105 w/3 methods	Alabama, Kentucky	Not noted	Not noted
Donahue 1978; Donahue et al. 1982	2	25 (AL 2, GA/FL 21, PA 2)	Alabama, Georgia/Florida, Pennsylvania	0	Not noted
Everett et al. 1980	2	89 w/2 methods	Alabama	Not noted	Not noted
Hopkins et al. 1980	2	233 w/2 methods	Mississippi	Not noted	Not noted
Kennamer et al. 1980	2	32 w/2 methods	Alabama	Not noted	Not noted
Speake 1980	2	298 w/2 methods	Alabama	Not noted	Not noted
Exum et al. 1985	2	12	Alabama	Not noted	Not noted
Holbrook and Vaughan 1985	2	30 adult/sub adult, 26 poults	Virginia	5	50.4 adult, 26.4 poult
Metzler and Speake 1985	2	Not noted	Alabama	Not noted	Not noted
Speake et al. 1985	2	Not noted	Alabama	Not noted	Not noted
Anonymous 1988	Not noted	88	Georgia	Not noted	Not noted
McDougal et al. 1990	2	64 w/2 methods	Virginia	Not noted	Not noted
Seiss et al. 1990	2	38 w/2 methods	Mississippi	Not noted	Not noted
Sisson et al. 1990	2	37	Georgia	Not noted	Not noted
Sisson and Speake 1991	2	26	Georgia	Not noted	Not noted
Lint et al. 1995	Not noted	88	Mississippi	Not noted	Not noted
Peoples et al. 1995	2	67	Georgia/Florida	Not noted	Not noted
Miller et al. 1996	2	w/2 methods	Mississippi	Not noted	Not noted
Rumble and Anderson 1996	2	111 w/3 methods	South Dakota	Not noted	Not noted
Lovell et al. 1997	Not noted	Not noted	Mississippi	Not noted	Not noted
Hubbard et al. 2001	2	Not noted	Iowa	Not noted	Not noted

Turkeys fed according to pecking order. The largest males were first to feed followed by young males, females, and finally, subadult females. Each turkey reacted differently to the effects depending on the amount of bait consumed, movements and activities of other turkeys, and sounds external to the quarantine rooms. Some turkeys regressed from Stage II (mild narcosis) or III (moderate narcosis) back to Stage I (light sedation) after other turkeys or external sounds disturbed them.

During the study, 126 captures of 84 unique turkeys were made with AC over 3 capture events. We experienced no capture myopathy, morbidity, or mortality in our study.

Literature Review

Databases searched contained reports that dated back to the 15th century with the majority of records having been published since 1884. Search terms used were turkey, wild turkey, chloralose, and turkey plus chloralose.

We found 35 publications that referenced the use of AC on wild turkeys (Table 2) The first use of AC on wild turkeys was in Florida during 1966 (Williams 1966), which was also the state with the most publications on AC use in turkeys. Nine additional states (Alabama, Georgia, Iowa, Kentucky, Pennsylvania, Mississippi, South Dakota, Texas, and Virginia) were found to have used AC on wild turkeys. Subspecies of turkeys listed were Merriam's (*M. g. merriami*), Rio Grande (*M. g. intermidia*), Osceola (*M. g. Osceola*), and Eastern (*M. g. silvestris*). No mention was made of the use of AC on Gould's turkeys. The last cited use of AC on wild turkeys was in March 1995 in Iowa (Hubbard et al. 2001). The primary papers being referenced as providing direction on the use of AC in wild turkeys were Williams (1966), Williams et al. (1966), and Williams et al. (1973*a*).

DISCUSSION

For almost 30 years, AC was one of the most commonly used tools to capture wild turkeys in the United States (Table 2). Anecdotally, AC had been used annually by many states for capture, research, and management of wild turkeys (B. Maddrey, National Wild Turkey Federation, personal communication). Many of these states may have data within their historical files that could be used to further registration purposes.

Following the protocol initially set by Williams

(1966) and within the guidelines set by FDA, AC is a safe and effective tool for anesthetizing wild turkeys. Gould's turkeys fed according to pecking order on the piles of baits which had enough AC for up to 3 turkeys per bait pile. The largest males were first to feed followed by young males, adult females, and subadult females. We speculate that by feeding in this order, turkeys self regulated the AC dosage by the largest bird ingesting the largest share of treated bait and the smallest bird ingesting the least amount of treated bait (i.e., correlating bait intake to body size).

Our results agree with Williams (1966) in that dosages below 2 g AC per cup of cracked corn were ineffective in sedating Gould's turkeys. Turkeys should be maintained in a warm and dry condition during anesthesia. Williams et al. (1966) found that wild turkey body temperatures rise sharply to as high as 42°C and then gradually decline for several hours to as low as 34°C. If the air temperature drops below freezing, anesthetized turkeys can succumb to hypothermia. In addition, water sources should not be present to prevent drowning (Williams 1966). The majority of Gould's turkey reacted similarly to turkeys in Florida, which took 1.5 hours to reach narcosis and 2–3 hr to reach a state of anesthesia (Williams 1966). Our experience with AC in this study addressed many concerns regarding losses of Gould's turkeys due to handling identified by Breland (1988), Wakeling (1998), and Wakeling et al. (2001). We also hypothesize that the use of AC may actually alleviate stress in wild turkeys as suggested by Donahue et al. (1982).

MANAGEMENT IMPLICATIONS

Alpha chloralose continues to be a viable and important tool in the conservation and restoration of turkeys. Based on our study, limited published literature, and the potential for additional information in the archives of agencies and organizations, we recommend that WS continue to collect data on AC and petition FDA to add turkeys to the current INAD-6602.

ACKNOWLEDGMENTS

We would like to acknowledge M. Adkins, S. Baker, R. Day, G. Gonzales, J. McDivett, and D. Winterboer for assisting with the AC baiting and captures. We would like to thank the anonymous reviewers for their constructive critiques. We would also like to thank K. Fagerstone, J. Jones, C. Bausch, and their staffs in acquiring permission from the FDA to use the product on Gould's turkeys, and T. Hall and G. Littauer for their work to meet National Environmental Policy Act compliance.

LITERATURE CITED

Anonymous. 1988. Wild turkey Mycoplasma research Update. Southeastern Wildlife Disease Study 4:2.

Arizona Game and Fish Department. 2001. Wildlife 2006. Arizona Game and Fish Department, Phoenix, Arizona, USA.

Austin, D. H., T. E. Peoples, and L. E. Williams, Jr. 1973. Procedures for capturing and handling live wild turkeys. Proceedings of the Annual Conference of the Southeastern Association Game and Fish Commissions 26:222–236.

Balis, G. U., and R. R. Monroe. 1964. The pharmacology of chloralose. Psychopharmacologia 6:1–30.

Barwick, L. H., D. H. Austin, and L. E. Williams, Jr. 1970. Roosting of young turkey broods during summer in Florida. Proceedings of the Annual Conference of the Southeastern Association Game and Fish Commissions 24:231–243.

———, and D. W. Speake. 1973. Seasonal movements and activities of wild turkey gobblers in Alabama. Proceedings of the National Wild Turkey Symposium 2:125–133.

Belant, J. L., L. A. Tyson, and T. W. Seamans. 1999. Use of alpha-chloralose by the Wildlife Services program to capture nuisance birds. Wildlife Society Bulletin 27:938–942.

Borg, K. 1955. Chloralose and its use for catching crows, gulls, pigeons, etc. Viltrevy Jakbiologisk Tidskrift 1:88–121.

Breland, W. R. 1988. Reintroduction of the Gould's turkey in southeastern Arizona. Proceedings of the Western Wild Turkey Workshop 4:12–26.

Donahue, M. A. 1978. The effect of the capturing drug, alpha-chloralose, on several blood constituents in the eastern wild turkey (*Meleagris gallopavo silvestris*). Thesis, Auburn University, Auburn, Alabama, USA.

———, M. E. Lisano, and J. K. Kennamer. 1982. Effects of alpha-chloralose drugging on blood constituents in the eastern wild turkey. Journal of Wildlife Management 46:468–474.

Everett, D. D., D. W. Speake, W. K. Maddox. 1980. Natality and mortality of a north Alabama turkey population. Proceeding of the National Wildlife Turkey Symposium 4:117–126.

Exum, J. H., J. A. McGlincy, D. W. Speake, J. L. Buckner, and F. M. Stanley. 1985. Evidence against dependence upon surface water by turkey hens and poults in southern Alabama. Proceedings of the National Wild Turkey Symposium 5:83–89.

Gardner, D. T. 1972. Dynamics of a recently established wild turkey population in the Alabama piedmont. Dissertation, Auburn University, Auburn, Alabama, USA.

Hillestad, H. O. 1973. Movements, behavior, and nesting ecology of the wild turkey in eastern Alabama. Proceedings of the National Wild Turkey Symposium 2:109–123.

Holbrook, H. T., and M. R. Vaughan. 1985. Capturing adult and juvenile wild turkeys with adult dosages of alpha-chloralose. Wildlife Society Bulletin 13:160–163.

Hopkins, C. R., D. H. Arner, J. E. Kennamer, and R. D. Clanton. 1980. Movements of turkeys in a high density population in the Mississippi Delta. Proceedings of the National Wild Turkey Symposium 4:272–279.

Hubbard, M. W., D. L. Garner, and E. E. Klaas. 2001. Factors influencing wild turkey poult survival in southcentral Iowa. Proceedings of the National Wild Turkey Symposium 8: 167–171.

Kennamer, J. E., J. R. Gwaltney, and K. R. Simms. 1980. Habitat preferences of eastern wild turkeys on an area intensively managed for pine in Alabama. Proceedings of the National Wild Turkey Symposium 4:240–245.

Lint, J. R., B. D. Leopold, G. A. Hurst, and K. J. Gribben. 1995. Population size and survival rates of wild turkey gobblers in central Mississippi. Proceedings of the National Wild Turkey Symposium 7:33–38.

Lovell, C. D., D. A. Miller, G. A. Hurst, and B. D. Leopold. 1997. Relationships between wild turkeys and raccoons in central Mississippi. Proceedings Eastern Wildlife Damage Conference 7:118–129.

Maddrey, R. C., and B. F. Wakeling. *This volume.* Crossing the border—the Arizona Gould's restoration experience. Proceedings of the National Wild Turkey Symposium 9:*This volume.*

McDougal, L. A., M. R. Vaughan, and P. T. Bromley. 1990. Wild turkey and road relationships on a Virginia National Forest.

Proceedings of the National Wild Turkey Symposium 6:96–106.

Metzler, R., and D. W. Speake. 1985. Wild turkey poult mortality rates and their relationship to brood habitat structure in northeast Alabama. Proceedings of the National Wild Turkey Symposium 5:103–111.

Miller, D. A., B. D. Leopold, and G. A. Hurst. 1996. Post-capture survival of wild turkeys: effects of age, sex and environment. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 50: 442–449.

Peoples, J. C., D. C. Sisson, and D. W. Speake. 1995. Wild turkey brood habitat use and characteristics in coastal plain pine forests. Proceedings of the National Wild Turkey Symposium 7:89–96.

Rumble, M. A., and S. H. Anderson. 1996. Microhabitats of Merriam's turkeys in the Black Hills, South Dakota. Ecological Applications 6:326–334.

Seiss, R. S., P. S. Phalen, and G. A. Hurst. 1990. Wild turkey nesting habitat and success rate. Proceedings of the National Wild Turkey Symposium 6:18–24.

Sisson, D. C., and D. W. Speake. 1991. An incidence of second brood production by an eastern wild turkey. Wilson Bulletin 103:303–305.

———, ———, J. L. Landers, and J. L. Buckner. 1990. Effects of prescribed burning on wild turkey habitat preference and nest site selection in south Georgia. Proceedings of the National Wild Turkey Symposium 6:44–50.

Speake, D. W. 1980. Predation of wild turkeys in Alabama. Proceedings of the National Wild Turkey Symposium 4:86–101.

———, L. H. Barwick, H. O. Hillestad, and W. Stickney. 1969. Some characteristics of an expanding turkey population. Proceedings of the Annual Conference of the Southeastern Association Game and Fish Commissions 23:46–58.

———, T. E. Lynch, W. J. Fleming, G. A. Wright, and W. J. Hamrick. 1975. Habitat use and seasonal movements of wild turkeys in the southeast. Proceeding of the National Wild Turkey Symposium 3:122–130.

———, R. Metzler, and J. McGlincy. 1985. Mortality of wild turkey poults in northern Alabama. Journal of Wildlife Management 49:472–474.

Spraker, T. R., W. R. Adrian, and W. R. Lance. 1987. Capture myopathy in wild turkeys (*Meleagris gallopavo*) following trapping, handling, and transportation in Colorado. Journal of Wildlife Diseases 23:447–453.

Wakeling, B. F. 1998. Survival of Gould's turkey transplanted into the Galiuro Mountains of Arizona. Pages 227–234 *in* G. J. Gottfried, C. B. Edminster, and M. C. Dillon, compilers. Cross Border Waters: Fragile Treasures for the 21st Century; Ninth U.S./Mexico Border States Conference on Recreation, Parks, and Wildlife. U.S. Forest Service Proceedings RMRS-P-5.

———, S. R. Boe, M. A. Koloszar, and T. D. Rogers. 2001. Gould's turkey survival and habitat selection modeling in southeastern Arizona. Proceedings of the National Wild Turkey Symposium 8:101–108.

Williams, E. S., and E. T. Thorne. 1996. Exertional myopathy (capture myopathy). Pages 181–193 *in* A. Fairbrother, L. N. Locke, and G. L. Hoff, editors. Non-infections diseases of wildlife. Second edition. Iowa State University Press, Ames, Iowa, USA.

Williams, L. E., Jr. 1966. Capturing wild turkeys with alpha-chloralose. Journal of Wildlife Management 30:50–56.

———, D. H. Austin, N. F. Eichholz, and T. E. Peoples. 1968*a*. A study of nesting turkeys in southern Florida. Florida Game and Fresh Water Fish Commission, Project Number Florida W-041-R.

———, ———, ———, ———, and R. W. Phillips. 1968*b*. Study of nesting turkeys in southern Florida. Proceedings of the Annual Conference of the Southeastern Association Game and Fish Commissioners 22:16–30.

———, ———, and J. Peoples. 1966. Progress in capturing turkeys with drugs applied to baits. Proceedings of the Annual Conference of the Southeastern Association Game and Fish Commissions 20:219–226.

———, ———, T. E. Peoples, and R. W. Phillips. 1973*a*. Capturing turkeys with oral drugs. Proceedings of the National Wild Turkey Symposium 2:219–227.

———, ———, ———, and ———. 1973*b*. Observations on movement, behavior, and development of turkey broods. Proceedings of the National Wild Turkey Symposium 2:79–99.

Windham, J. D. 1973. Specific characteristics pertaining to home range and territory selection and the test of oral anesthetics for trapping the Rio Grande turkey (*Meleagris gallopavo intermedia*) in southwestern Callahan County, Texas. Thesis, Abilene Christian University, Abilene, Texas, USA.

Woronecki, P. P., R. A. Dolbeer, and T. W. Seamans. 1990. Use of alpha-chloralose to remove waterfowl from nuisance and damage situations. Proceedings of the Vertebrate Pest Conference 14:343–349.

———, ———, ———, and W. R. Lance. 1992. Alpha-chloralose efficacy in capturing nuisance waterfowl and pigeons and current status of FDA regulation. Proceedings of the Vertebrate Pest Conference 15:72–78.

David L. Bergman (left) is the State Director for the United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services' Arizona Program. He earned his B.S. in wildlife biology from the University of Nebraska–Kearney. He served as a research technician, wildlife biologist and staff wildlife biologist for Wildlife Services from 1989–2001 which included overseeing drug registration issues and research for drug and pesticide registration.. Currently, David oversees a diverse program that includes wildlife damage management for airports, agriculture, property and natural resources. David is a Certified Wildlife Biologist. ***Brian F. Wakeling*** (middle) received a B.S. in Wildlife Management and an M.S. in Environmental Resources from Arizona State University in 1985 and 1989, respectively. He served as a research biologist for the Arizona Game and Fish Department from 1988–2000, during which time he studied turkeys, mule deer, elk, and bighorn sheep. Currently, Brian is the big game management supervisor with the Arizona Game and Fish Department, a position he has held since 2000. Brian is a Certified Wildlife Biologist and a Past-President of the Arizona State Chapter of The Wildlife Society. Brian has served as a member of the National Wild Turkey Technical Committee since 1993. ***Timothy B. Veenendaal*** (right) is currently working as a supervisory wildlife biologist for the Wildlife Services Arizona program. Prior to this position he worked with Wildlife Services in Washington and NWRC-Olympia Field Station. He received his B.S. in Fisheries and Wildlife from Utah State University in 1995. ***John D. Eisemann*** (not pictured) has been working in the field of Wildlife Biology for nearly 25 years. He studied Wildlife Biology as an undergraduate at Colorado State University. He went on to obtain a Masters'

in Environmental Science at the University of Maryland emphasizing contaminants in urban runoff and their impact on birds. During his years pursuing a career as a Wildlife Biologist, he worked for the U. S. Fish and Wildlife Service refuge system and in the contaminants lab at the Patuxent Wildlife Research Center. While at Patuxent, he became interested in the effects of industrial contaminants and pesticides on wildlife and was subsequently hired by the U.S. Environmental Protection Agency in the mid-1990's to conduct ecological risk assessments of pesticides. After two and a half years with the EPA, the USDA National Wildlife Research Center (NWRC) brought him on to manage their vertebrate pesticide and wildlife drug registrations. He has been with NWRC for 8 years. ***Thomas W. Seamans*** (not pictured) is a Certified Wildlife Biologist for the Wildlife Services/National Wildlife Research Center field station in Sandusky, Ohio. Tom has spent the last 18 years conducting research focused on finding biologically sound solutions to conflicts between people and wildlife. He received a B.S. degree in wildlife science from Cornell University and an M.S. in wildlife management from the Ohio State University.

Manuscript published in

Wild Turkey Management:
Accomplishments, Strategies, and Opportunities

Proceedings of the
Ninth National Wild Turkey Symposium

Grand Rapids, Michigan
10-14 December, 2005

Edited by

C. ALAN STEWART AND VALERIE R. FRAWLEY
Michigan Department of Natural Resources
Lansing, Michigan

Sponsored by

Michigan Department of Natural Resources

Hal & Jean Glassen Memorial Foundation

National Wild Turkey Federation

Michigan State University, Department of Fisheries and Wildlife

Michigan Chapter of The Wildlife Society

U.S. Department of Agriculture, Forest Service

Wisconsin Department of Natural Resources

Published by
Michigan Department of Natural Resources